AMATEUR WORK

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LARGE WIMSHURST MACHINE.

ROBERT GIBSON GRISWOLD.

Many of the experiments in high tension currents may be performed with this machine, especially those consisting of discharges through vacuous spaces such as Geisler and X-ray tubes.

The expense alone of constructing an induction coil capable of giving an eight-inch spark is very considerable, to say nothing of the stupendous amount of labor necessary in wrapping the secondary and building up the condenser. The machine to be described herein, on the other hand, is very efficient, cheap, durable and simple in construction.

Since the glass plates revolve at rather a high rate of speed and the slightest inequality either in size or weight will cause considerable vibration, the base must be made firm and fairly heavy. If possible, make it up from the strips of some heavy wood, such as well seasoned oak, glued together and mounted on the three battens *a*, *a'*, and *a''*, Fig. 3. One of these battens is placed directly beneath the plate supports. After the base is finished, dry it thoroughly in an oven and give it several coats of shellac varnish. This treatment also refers to every wooden part as these machines are easily affected by the slightest dampness and every precaution must be taken to prevent absorption.

The uprights supporting the plate shaft must be well fitted to the base and secured by three large screws passing through the under side, as well as being glued, the varnish being scraped away immediately beneath the posts. If this end is perfectly square no other brace will be necessary. The plate shaft passes completely through the rear support and is secured by the set screw *b*, Fig. 4, which is simply a wood screw with the end filed flat to give a bearing. In the front support the shaft enters a recess *d*, but does not go completely through.

The supports for the crank shaft at the right are similarly fastened ,but the upper ends are provided with bearings *e*, Fig. 4, in which the shaft turns. These are made of pieces of brass tubing which just fit the shaft, $\frac{1}{4}''$ in diameter. They are allowed to protrude slightly inside so that the tube *f*, upon which the driving wheels are mounted, may bear against them.

The driving wheels *c*, which are 5″ in diameter, are turned from a disc of cherry or mahogany $\frac{1}{2}''$ thick. Or each may be made by cutting two discs from $\frac{1}{4}''$ material, bevelling the edges and gluing them together with the grain crossing. This latter method is really the best as it prevents warping. They are mounted upon a piece of tubing *f*, of $\frac{1}{4}''$ bore which has soldered $\frac{1}{2}''$ from each of its ends brass washers *g*, or discs to which are secured the wheels by means of small screw. These brass discs should be about 2″ in diameter, $\frac{1}{16}''$ thick, and set perfectly square with the tube, as they are the only support to keep the wheels from running out of true. The shaft is made from a piece of $\frac{1}{4}''$ cold rolled, or Stubb's steel, the latter being preferred on account of its truth. The crank is made by bending the rod (while hot) twice at right angles and providing a handle of wood or ebonite,

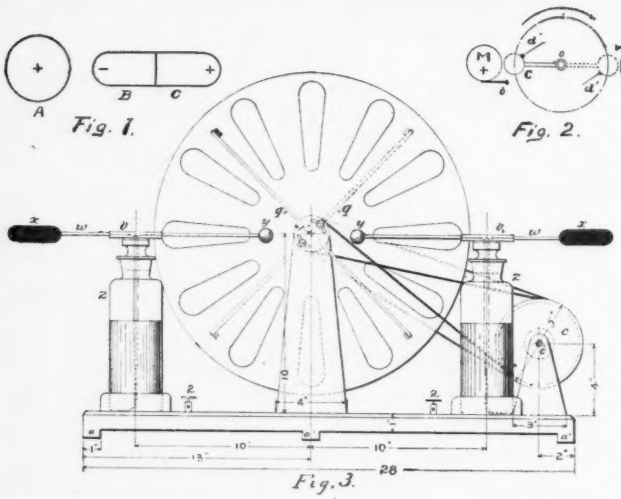


Fig. 1.

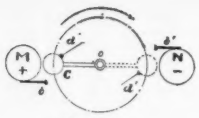


Fig. 2.

Fig. 3.

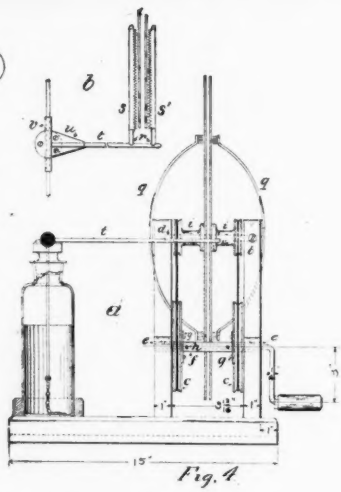


Fig. 4.

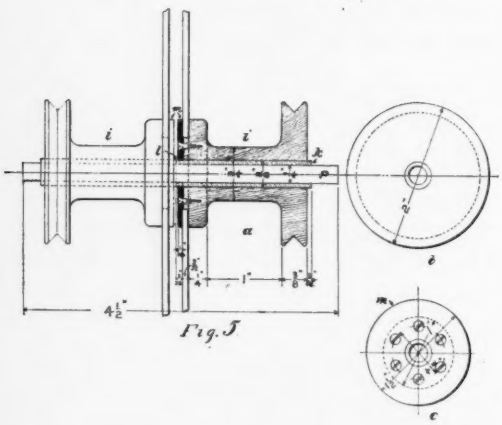


Fig. 5

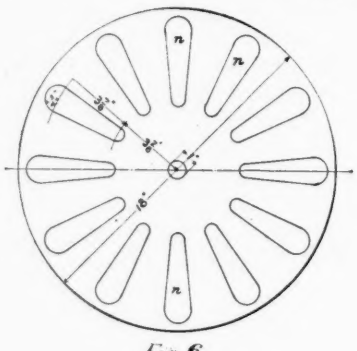


Fig. 6.

which may be secured by filing a shoulder on the end of the rod and rivetting a washer thereon. Two small holes may be drilled through the tube, and shaft and pins *h* inserted to keep the shaft from turning.

The glass plates are mounted upon spools *i*, Fig. 5, turned from ebonite, if possible, or some hard wood. The ebonite is better. Before turning, a piece of the same brass tubing mentioned before should be driven into a hole drilled in the block of ebonite or wood of such a diameter that the tube will fit very tight therein, as at *k*. The inside diameter of the tube should be a snug fit on a ¼″ Stubb's steel rod. If it is possible to get a ¼″ reamer, the tube may be of slightly smaller inside diameter and reamed out. These spools are to be turned up on a piece of this rod as a mandril to insure their running in perfect truth, for if out only a very little, it may result disastrously when the plates are mounted and running. The tube *k* extends completely through and beyond the inside end so that the ends may bear against each other as at *i*. The plates are held in place by the fibre washer *m*, the latter being secured by six screws as shown in Fig. 5, *c*. A slight clearance is allowed between the spool face and this washer so that it may exert the necessary pressure against the glass.

The glass plates are the only part requiring any great amount of labor in their preparation, but these will require patience and great care. They are 18″ in diameter, and cut from sheets of "crystal" window glass that is perfectly free from air bubbles or flaws of any description.

Select two that are nearly level as possible, testing them by means of a straight edge. Oftener these sheets will be thicker on one end than on the other and such should not be used. As the greatest danger of breaking lies in drilling the hole in the middle, it should be drilled first; and when this hole is drilled the outer circle may be marked off with greater accuracy with regard to the centre. The hole in the middle, which is 1″ in diameter, may be readily drilled if the following instructions are carried out. Harden several small drills about $\frac{1}{16}$″ or $\frac{3}{32}$″ diameter by heating them to a cherry red and plunging them into mercury, if at hand, or into very cold water. These drills must be very hard as the glass wears them away rapidly. Then grind them to a very keen edge, especially on the point as this must enter before the drill can cut. To wet the drill and make it "bite" use the following solution: dissolve as much gum camphor in turpentine as it will take and keep the drill liberally wet while drilling. The drilling may be done either with a small hand drill or a sensitive drill-press, but too much pressure must be avoided, as the glass is very brittle.

Place the glass plate upon a smooth, level board and see that it bears quite evenly at all points. Under the spot to be drilled put a piece of rubber or leather to take the pressure of the drill so that it will yield slightly. Drill about half way through on one side and then turn the plate over and drill from the other side. The greatest danger lies at the point of breaking through with the drill, but if it is done slowly and carefuliy, little fear of breaking need be entertained.

After this hole has been drilled through, gradually work it larger with a very fine cut round file wet in the turpentine solution. The glass will be found to cut quite easily and it does not take long to file the hole to the full diameter. The writer used a set of round files held in a drill chuck. The cut is then scraping in character very rapidly made and the hole is quite smooth. The files are run at a very high speed and the plate moved about so that the cutting is done in a continous circular line.

Another method of using a brass tube charged with emery and water is much recommended, but the writer's experience has been that with thin plates the former method gives the best results as no great pressure is put upon the glass.

After the hole is trued to 1″ inside diameter, lay it on the board above referred to and with a compass mark off the exact centre. Then make a trammel from a bar of hard wood about $\frac{3}{4}$″ square and in one end drive a sharpened nail to serve as a centre. In the other end drill a hole to receive a glazier's diamond so that the cut of the diamond will be just 9″ from the centre of the hole, (The cheap wheel cutters sold on the market are not very safe to use for this work as the cut is very uncertain.) With the nail in the centre just laid off, and the diamond held firmly in one hand, swing the latter in a complete circle exercising care to see that a clean cut is made all way round. Then make radiating cuts from this circumference to the edges of the plate and proceed to break off the different pieces until the circle is complete. If the cuts made by the diamond are clean and not scratched this can be done without difficulty. The edge may then be ground smooth with fine emery cloth and oil. Make two plates of this size.

Then lay off on a sheet of paper, full size, the position of the twelve tinfoil sectors *n* from tinfoil of the size given and attach them to the glass plates, twelve on one side only of each. The plates should have been thoroughly cleaned and varnished with shellac and allowed to dry before this is done. Lay the varnished plate on this marked paper sheet, place the tinfoil sectors over the positions marked on the paper and fasten them by holding a warm flat-iron over them until the shellac melts sufficiently to hold them. It is better to use just the tip of the iron as too much heat will crack the plate. These sectors cannot be readily fastened by shellac varnish as the foil prevents the evaporation of the alcohol with which the varnish is made. Boiled linseed oil or Japan dryer are both better, but if the heating is carefully done, no better job can possibly be desired.

Before mounting on the spools, the surface of the plate just around the hole should be roughed with emery cloth and both the spool-shoulder and plate coated with a little very thick shellac. Secure the plate in place by means of ebonite

washer and screws and when the varnish has dried it will be found to be firmly cemented in place.

The shaft *b* upon which the plates revolve is made of $\frac{1}{4}''$ Stubb's steel, used on account of its being finished to size. The neutralizing brush holders *q q* are made of $\frac{1}{8}''$ spring brass wire, bent to the form shown. At the middle they are soldered to a brass disc 2″ in diameter and provided with two slots through which round-headed screws pass to serve as an adjustment for brush position, if found necessary. On each end is soldered a small brush made of tinsel and of such length that it just touches the foil sectors as they pass beneath them. Very thin, springy brass wire will answer but it is very apt to wear away the foil after a short time. The brushes should be flat rather than of a large area, say $\frac{1}{2}''$ or $\frac{3}{4}''$ across. Small sheet brass washers should be placed between the plate supports and the tube *k* for the latter to bear against.

The collecting combs are placed diametrically opposite and surround the plates as at *b*, Fig. 4. The supporting frame for the combs is made by soldering three pieces of $\frac{3}{16}''$ brass rod together at *r* and soldering the combs, made by filing very sharp teeth in two strips of sheet brass, to the pieces *s s*. These combs do not touch the plate but come within $\frac{3}{16}''$ of the foil sectors as they pass and should be of the same length. The rod *t* is soldered to the brass plate *u*, to which is also soldered at right angles to *t*, a 3″ piece of brass tubing *v* split at the ends so that a snug sliding fit may be made for the discharging rods *w w*. Beneath this plate is soldered a wire that passes through a hole in the stoppers of the Leyden jars *z z*. To the end of this wire is soldered a short length of brass chain which makes contact with the inside coating of the jars. The plate is fastened to the stoppers by three small screws. File the ends of the rode *t*, *s*, *s*, to a spherical shape as sharp, squares corners aid materially in dissipating the charge.

The discharging rods are tipped with a $\frac{3}{4}''$ polished brass ball on one end and provided with an ebonite handle on the other. An accidental shock from a machine of this size is not a pleasant thing thing to contemplate, and ebonite forms a safer handle than wood. The rods *w* should be long enough to bring the balls together when pushed in.

These discharging rods and collecting combs are mounted on the wooden stoppers of two Leyden jars, provided for the purpose of accumulating sufficient electrical energy to raise the potential to such a point that a long spark may be obtained. Otherwise, a slight hissing discharge will take place, or visible in the dark as a bluish brush. These stoppers are turned out of cherry to fit the mouths of wide-mouth (salt-mouth) bottles, about eight or nine inches high, three inches in diameter with mouths about two inches in diameter. Such bottles may be secured from any druggist and should be perfectly sound and free from flaws. Thoroughly clean, dry, and coat the inside and outside to a height of five inches with tin foil. To attach the foil to the inside, coat the glass with a very thin film of shellac varnish and apply the foil in a sheet by wrapping it first around a cylinder of wood about 1″ in diameter; place the cylinder so wrapped inside, and after the loose end of the foil is attached to the side, unwrap the foil by rolling the cylinder around the inside. Press closly to the glass with a brush or wad of cloth on a stick. Cover the bottom also, seeing that the bottom piece and that on the side is in contact. The outside is easily covered, but instead of putting a separate piece on the bottom, let the side strip extend beyond the bottom edge for about two inches. Split overhanging portion into $\frac{1}{2}''$ strips and cement them in an even layer on the bottom. Place in an oven to dry, and when bone-dry give the wnole of the exposed (or uncovered) glass inside, and the entire outside with the exception of the bottom, an even coat of shellac varnish. The inside coating and the bottom on the outside must not be varnished. This varnish prevents a film of moisture collecting on the surface of the glass, which would cause leakage of the charge.

The jars are secured in place by cementing them into two wooden cells fastened to the base. In the bottom of each cell is a piece of thin sheet brass which is attached either by a wire or an extension of itself to one of the binding posts *2 2*. Use glue or plaster of Paris to cement the jars in place, exercising care to see that the outer coating and brass strip are in good contact.

The plates are driven by means of small round leather belts such as used on sewing machines, one belt being twisted so that the plates will revolve in opposite directions. With the neutralizing brushes placed as shown, the front plate should revolve with the hands of the clock and the rear plate counter-clockwise.

When the machine is discharging between the knobs, the two binding posts should be connected together with a wire, as the jars will not work properly when not so connected. At other times wire may be connected thereto for carrying discharges to a distance for experiments. This machine is self exciting, but all influence machines will work better in dry than damp atmosphere and it should be kept as free from dust as possible.

WOOD TURNING FOR AMATEURS

F. W. Putnam, Instructor Manual Training School, Lowell, Mass.

IX. EXERCISES IN ORNAMENTAL TURNING.

Ornamental turning in wood has so wide a range, that illustrations by practical examples can necessarily indicate but few of its results. The series of designs that follow, presents no difficulties, but gradually increasing elaboration in form and manipulation. Skill is, of course, an essential, but if the amateur is possessed of a fair set of tools, and a really thorough determination to use them to their utmost, he will be able to make such a variety of articles, both ornamental and useful, that there need be no fear of the work becoming monotonous for want of variety.

As a rule, delicate objects should be turned from hard wood. The lumber must be well seasoned and free from checks. "Built up" pieces of black walnut and light colored woods, such as ash, chestnut, beech, maple, or oak serve admirably for ornamental work. The pieces should be in thin strips, and should be carefully glue sized before the final gluing.

There are two kinds of gum wood, white and black. Both are excellent for turning, as they do not readily split. Cedar, cherry, rosewood, box wood, butternut and mahogany are also good. Hemlock, if it can be obtained free from checks, makes beautiful work. All dead knots should be carefully sawed off.

"Built up" blocks may be made by gluing up woods of different colors, but of the same general character as regards hardness. If this latter precaution be neglected, the result will be very unsatisfactory, for where two or more woods of different degrees of hardness are glued up together, side by side, the tool will act upon the hardest very well, but will glide or spring over the softer material, thus leaving an uneven surface. White holly and ebony make a good combination, as do amaranth and ebony. Ebony is, by some, considered a hard wood, but to me the average piece of ebony seems quite soft, as compared with rosewood and cocoanut which are truly hard woods.

Many amateurs will not be content with our native woods but will go to the dealers in foreign woods, leaving our native woods for foreign woods of deeper color and harder grain. To my mind, however, there are very few foreign woods with as hansome a grain as the chestnut, cherry, ash, black walnut, California rosewood, oak, and curled maple.

Foreign woods are expensive, and many varieties are almost unobtainable, the dealer in these woods generally carrying in stock only those that are used in the arts and trades.

Indian Clubs.

The Indian Club shown in Fig. 14, may be made from one block of wood, or "built up" as shown in Fig. 75. The chief objection to the first method is, that nearly one half the block is wasted in turning it up to the required shape. The second method, which is the one to be explained here, requires, of course, perfect joints; but the amateur should have no trouble with this

part of the work, if he is careful in planing up and testing the surfaces that comes together.

For the centre stick or "core", maple or birch, 20″ long, and 1 ¼″ square when planed, is to be used. This stick must be carefully planed and tested to make sure that the four sides are exactly the right width, 1 ¼″, and that they are at right angles to each other.

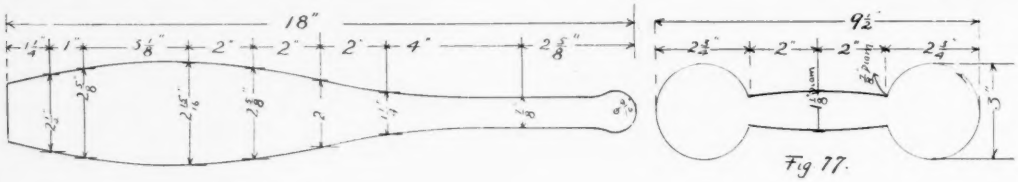


Fig 74. Fig 77.

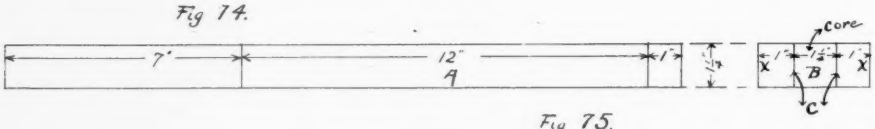


Fig 75.

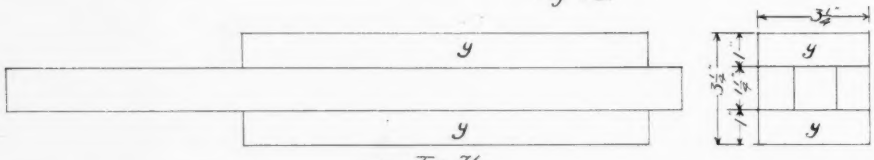


Fig. 76.

For the four outside pieces, all 12″ long, black walnut or cherry is to be used. The two pieces marked *x* in *B*, Fig. 75, are then to be prepared. These two pieces are planed true on the side marked *c* in *B*, Fig. 72, coming next to the sides of the core. If possible, these pieces should be in the rough, 12″ long, 1 ⅜″ wide and 1 $\frac{1}{16}$″ thick Glue size the two sides that have been planed, using hot cabinet makers' glue if possible. Next put on a heavy second coat of glue and clamp together tightly with either wood or iron clamps, the ends of these pieces coming 1″ from the end of the core, as shown in Fig. 75. These pieces should be left until the next day, before being removed from the clamps. When this has been done, the block is next to be carefully planed on both sides until it is exactly the thickness of the core, 1 ¼″.

The two pieces marked *y*, Fig. 76, are next planed on one side, glue sized and finally glued and clamped to the block just prepared, the block now being "built up" as shown in Fig. 76. These two pieces *y*, are 12″ long, 3″ wide, and 1″ thick. This block, it will be noticed, is 3 ¼″ square; the largest diameter is 2 $\frac{3}{15}$″, so that the pieces may be a little less than 1″ thick, if thicker material cannot be obtained.

The finished club is 18″ long, and the block from which it is turned is 20″ long, allowing 1″ on each end for removing the centre marks. There should be no difficulty in turning up the Indian club and only a few suggestions will be offered for the work.

The block is much longer than any previous exercise, so that the rest will require shifting. Run the lathe at the slowest speed until the block is roughed down with the gouge. The concave curves are to be finished, and the convex curves approximated with the gouge. Do not finish the neck of the club until the last thing, as the diameter is so much smaller than the rest of the work that the block would be liable to "chatter" if the neck were finished to size first. The ball on the end is to be 1 ⅛″ in diameter. If desired, a ½″ bead can be cut near the other end of the club, say 3″ from the end. The block must be very accurately centred, otherwise the ends of the outside pieces, where they join the cue at the neck, will not have the same curve.

When the turning is finished, sandpaper with No. 1 ½ sandpaper, finishing with No. 0. The club should now be given two coats of raw linseed oil. When thoroughly dry, sandpaper very lightly and apply a light coat of white shellac, if

a polished finish is desired. When dry, rub the shellac lightly with No. 00 sandpaper and apply a second light coat of white shellac, rubbing with sandpaper, when dry, as before.

These two light coats of shellac will thoroughly fill the pores of the wood. A third coat of white shellac, a little heavier than the first two coats, is then applied. When dry this coat is to be rubbed down to a polished surface with pumice stone and oil. If a smooth finish is all that is required, use white shellac and oil together on a cloth, rubbing the club with this until it is perfectly smooth. The oil prevents the shellac from sticking to the wood and gumming up the surface.

Dumb Bells.

This exercise requires a block of maple 11″ long, and 3″ square. Turn the handle first, using for this the ¾″ skew chisel. The largest diameter is 1 ⅛″, the handle tapering to ⅞″ diameter at the sides. Next mark a line which shall be 1 ⅝″ from the end of the handles; this line will be the centre line of the ball. Using this centre line as the starting place for the gouge cuts, approximate the spherical form, and finish the curves with the skew chisel, exactly the same as in the regular bead exercise. The inside should be turned first and then the outside. The ball should be cut under a little on the outside edge to keep the spherical form.

When the ends have been turned, the extra stock next the centres is cut off, first cutting down with the parting tool and acute point of the skew chisel, and finished when the dumb bell has been removed from the lathe, after being sandpapered, with a chisel and file. A templet, cut to a little less than a semicircle of the required diameter, 2 ¾″, will be useful in turning the ball down to size. The dumb bell should be finished with oil and shellac as previously described.

PROJECTION.

Carl H. Clark.

IX. ISOMETRIC PROJECTION.

In all the foregoing constructions the projections of the objects have been obtained by the construction of plans and elevations. Isometric Projection, on the other hand, shows the complete object in one plan ; moreover, all the lines can be measured by a uniform scale. The effect is somewhat similar to a perspective drawing except that the sizes of the various parts do not diminish as they recede from the eye as in perpective.

The system of isometric projection is based on the appearance of a cube resting on one of its corners, while the base is raised until one diagonal is parallel to the horizontal plane, and rotated until the diagonal is at right angles to the vertical plane. The vertical projection or elevation of the cube in this position is a regular hexagon. The process is shown in Plate 28, where Fig. 1, is the projection of the cube resting on the horizontal plane. Fig. 2, shows it after it has been tipped up until the diagonal *c-g*, is horizontal and parallel to the vertical plane; in Fig. 3, it has been turned so that the diagonal *c-g*, is perpendicular to the vertical plane. The vertical projection in Fig. 3, is called an isometrical projection.

The sides *c d c b c e*, are all equal, as we know they should be in a cube, but as will be seen, they are shorter than the true length shown by *c e*, Fig. 2, but since they are all shortened proportionately, this shortening may be neglected and the lengths be taken as representing the actual lengths; *c-e c-h c-d* are called isometric axes and it is to be noted that *c-e* is vertical and *c-d c-b*, are at angles of 30° with the horizontal.

To make an isometrical drawing of a cube Fig. 4, at the point *c*, draw *e c a* vertical and *e n* and *e f* at an angle of 30° with the base line, lay off *e-n e-c e-f* equal to the side of the cube; draw *c-d*, and *c-b*, parallel to *e-n*, and *e-f*; draw *n-d f-b*,

vertical; finally draw *d-a*, *b-a*, parallel to *e-n*, and *e-f*, which completes the projection.

Fig 4, is the isometrical projection of Fig. 1, as may be seen by comparing the length of the sides; but it should be noted that the isometric projection is much larger. In a large object this fact will produce considerable distortion, so that if desired, an isometric scale may be constructed to take account of the foreshortening, but this is not customary.

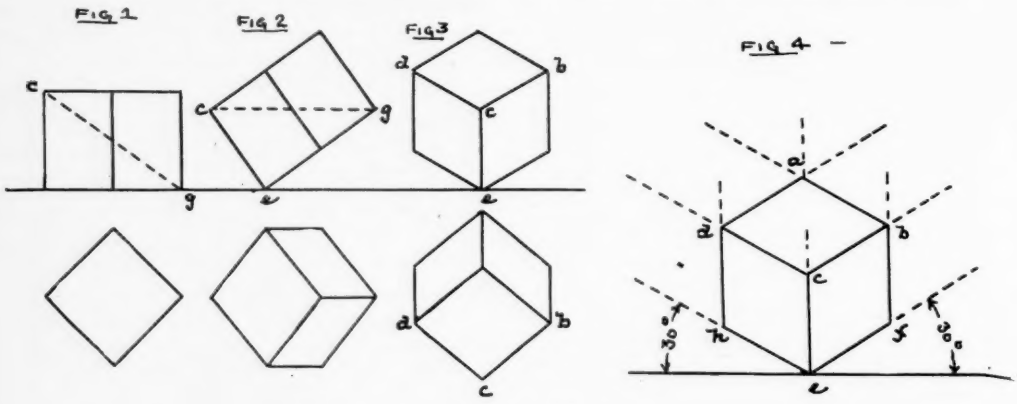


PLATE 28.

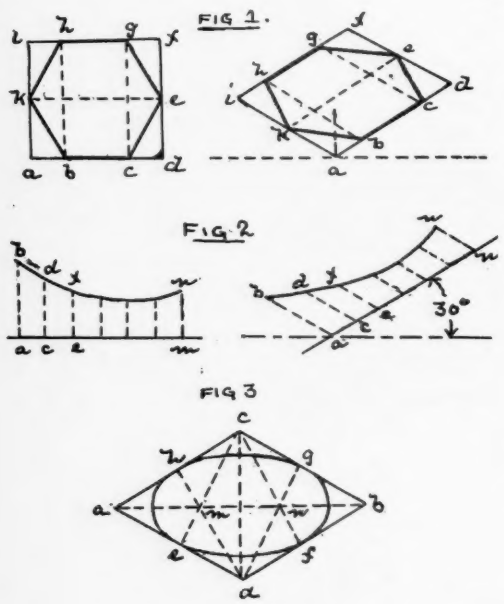


PLATE 29.

Referring to plate 29, Fig. 1, is the outline and isomertical projection of a hexagon. Since by this method we can only deal with points, it is best to inscribe a rectangle around the hexagon as shown. The lines *a-d* and *a-i* are drawn at 30° with the base line and the distances laid off on them, then *i-f* and *d-f* are drawn parallel to the other two, forming the projection of the rectangle; the sides *a-i* and *f-d* are bisected for the corners *a* and *k* *a-b* and *a-c* are laid off and lines drawn parallel to *a-i* locating *g-h*. Now the points *a-g* *h-k* *b-c* are connected by straight lines giving the outline.

If desired, the base could equally as well have been placed on *a-i* instead of *a d*. Fig. 2, is the outline and isometric of an irregular curve *b-d-f* *n*. To obtain the isometrical drawing, make *a-m* at 30° to the base; starting from any point, lay off *a-c* *c-e* etc., equal to those in the left hand figure, and draw *a-b* *c-d* *e-f* at 30° also and make the distances equal to those of the other figure and connect the points with a smooth curve. This drawing also could have been made on the other axis if desired.

Fig. 3 is the isometrical drawing of a circle. The square is first circumscribed about it, the isometrical projection of the square drawn as before and the middle points of the sides *g-h* *e-f*, located. The outline of the circle is an ellipse touching the square at these points, and may be drawn by any desired method; as a suffiicently close approximation to the outline, the following method is good. Draw the lines *c-e* *a-h*

c-f *a-g* intersecting the longer axis in the points *m* and *n*; with *m* as a centre draw the circular arc *e-h* with *n* as a centre draw *f-g*, and with *a* and *c* as centres draw the arcs *g-h* and *e-f*. This is an approximation, but is sufficiently exact for ordinary purposes.

It will be seen from the foregoing directions that this method of projection deals particularly with points, and in locating any figures it is simply necessary to locate a sufficient number of points to complete the outline and connect them with curves or straight lines as the case may be.

As an exercise it is suggested that the student make the isometrical projections of a cube 2″ on a side, a triangle 2″ base, and 2″ attitude, and some irregular outline.

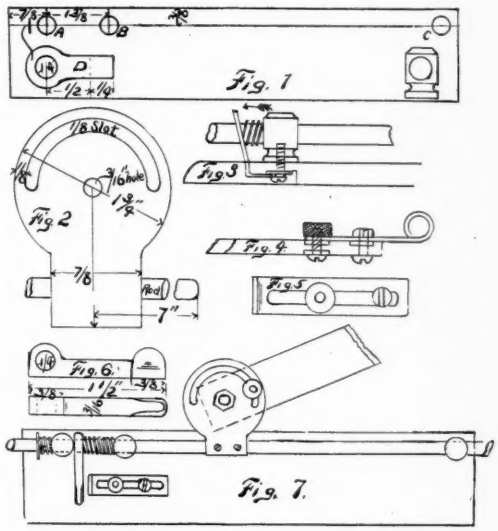
A SECTION LINER.

C. R. Sawyer.

A section liner is an instrument often needed by draftsmen, but is frequently not included in their outfit. The directions here given for making an excellent instrument may be of interest, therefore, to many readers of this magazine, as it is easily made at small cost.

The first thing required is a piece of mahogany or maple, 10″ long, 2″ wide, and $\frac{1}{4}$″ thick. The edges on one side should be nicely rounded, and the surfaces then smoothly sandpapered and varnished. Three holes are then bored as indicated in Fig. 1, to receive screws for binding posts of the shape shown. Posts of this pattern can be obtained of any large electrical supply dealer, and are mounted on the upper side, the heads of the screws being countersunk on the under side to their full thickness, so they will not project and prevent the wood strip from lying flat on the drafting surface. Care should be used to see that the posts are in a perfectly straight line. Before mounting the posts it will probably be necessary to drill the holes out to a larger size, a full $\frac{1}{4}$″ being the required diameter of the holes, which should receive with an easy fit, a piece of $\frac{1}{4}$″ round brass rod, 16″ long; care should be taken to see that this rod is perfectly straight and smooth. The ends are rounded with a file and emery cloth.

A narrow slot is also cut through the base $\frac{3}{16}$″ outside of the post *A*, to receive the binder *D*. The best way to make the slot is with the point of a sharp knife-blade. The binder is made of thin spring brass, the case of an old alarm clock furnish suitable material. A $\frac{1}{4}$″ hole is drilled in the larger end and filed out to fit the rod easily. The small end is forced through the slot from the upper side, so that the hole will line with those in the binding posts, using the rod for adjusting it. The right position being secured, the end



projecting on the under side is bent over to come under the head of the washer holding the post *A*, as shown in Fig. 3.

From a piece of thin, stiff brass, 2 $\frac{1}{2}$″ x 1 $\frac{3}{4}$″ cut out the shape shown in Fig. 2. The slot can be worked out by drilling holes and finishing with a small, half-round file. The long end is bent into a cylinder to tightly fit the rod, two holes for 2-56 machine screws being drilled and tapped to

hold in place, so that the hole in the centre of the circular part will be 7″ from the end of rod.

Obtain a box wood ruler 9″ long, and 1″ wide, bore a $\frac{3}{16}$″ hole, $\frac{1}{2}$″ from one end, the beveled edge being on the under ruling side, and $1\frac{1}{16}$″ from the first hole bore another. The hole nearest the end receives a machine screw and the other hole, preferably a binding post of the shape used for dry battery connections, as shown in Fig. 4. These are obtainable of the Manhattan Electric Supply Co. Cortland St., New York, the catalog number being 4836, and the price five cents each. With the knurled nut, adjustments to any angle can be easily made.

Another binding post of the shape just mentioned is needed for the spacer. This is made up of a piece of stiff brass *a*, the binding post *b*, and a round head wood screw *c*, as shown in Fig. 5. The piece of brass is 2″ long, and $\frac{3}{8}$″ wide, $\frac{1}{4}$″ of one end being bent up, and a slot $1\frac{1}{2}$″ x $\frac{1}{8}$″ cut in the flat part. The binding post is mounted on the base $\frac{1}{2}$″ from the edge and in line with binding post *B*. The wood screw is put in $\frac{1}{2}$″ from the post serving to prevent side play. The end bent up acts as a stop to the bar *E*, Fig. 5. This bar is a piece of brass rod, $1\frac{1}{2}$″ x $\frac{3}{8}$″ x $\frac{3}{16}$″ filed out to the shape shown in Fig. 6. The $\frac{1}{4}$″ hole in the end is a sliding fit for the travelling rod.

The parts can now be assembled, as shown in Fig. 7. The binding post *C*, is removed from the base, one end of the travelling rod placed through the hole *B*. Over the rod, place a piece of stiff brass spiral spring about 1″ long, pass the rod through post *A*. Place another piece of the spiral spring $\frac{1}{4}$″ long, on the rod and between the post *A*, and the flexible brass binder, and then push rod through binder, which, forced outward by the small spring, binds on the travelling rod and holds it in position. The spacer is then set to regulate the travel of the rod, the bar *E*, as it is pulled with the finger towards the spacer, carrying the rod with it. The pressure of the finger being removed, the long spring forces the bar *E*, back to the post *A*, and this is continued as desired. The spacer can be adjusted to give very fine or wide sectioning.

When the top is complete, two needle points are forced into the under side of the base, one at each end, so that the points project only about $\frac{1}{16}$″. These hold the liner in a fixed position.

AN ACETYLENE LAWN LAMP.

John B. Gardner.

This lamp was made to furnish light for a croquet ground, the lighting previously having been by gasolene torches which were troublesome, odorous, and uncertain, and needing constant attention. Six lamps like those here described, provide much more light than previously, require but little care and are so satisfactory that anyone desirous of an outdoor light is recommended to give it a trial.

The required materials are inexpensive, in many families the necessary cans and pails being already at hand. Tbe outer can *A*, is a 5 pound coffee tin, measuring 7 $\frac{1}{4}$″ diameter, and 7 $\frac{3}{4}$″ high. At opposite sides are soldered two pieces of $\frac{1}{8}$″ round brass or galvanized iron rod, *F*, each 6″ long, the part projecting above the can being 4″ long.

The gas-bell *B*, is a lard pail 6″ diameter, and 7″ high. The cover is also used, so must not be discarded. To the bottom of the pail are soldered two strips of thick sheet tin *E*, 2 $\frac{1}{2}$″ long, and $\frac{3}{4}$″ wide, each piece having a hole near the end large enough to freely admit the brass rod *F*, and the strips so located when soldering in place, that the bell will be in the centre of the tank *A*. To the other or cover end of the pail, are soldered two strips of thick sheet tin iron, *D*, 3 $\frac{1}{2}$″ long, and $\frac{1}{2}$″ wide, bent to the shape shown, and forming catches to hold the cover on and yet allowing its easy removable.

In the centre of the cover punch a round hole about 1″ diameter, and around the edge about six $\frac{1}{4}$″ holes for admitting the water to the inside of the pail.

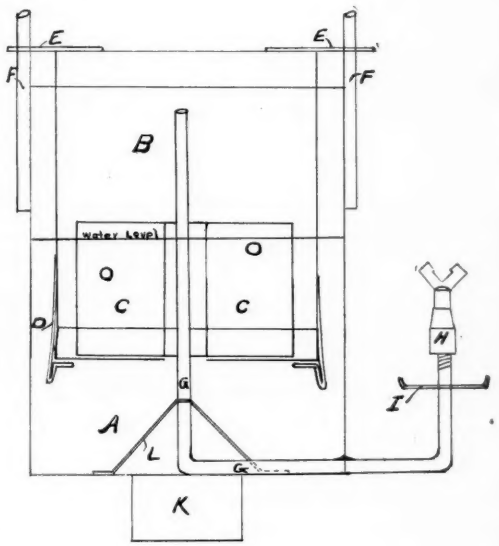
The carbide holder, *C*, is a round can 5″ high, in the centre of which is a tubular opening 1″ diameter and the full height of the can. This tube can easily be fashioned from an old tomato can and soldered in, using care to see that the joint is a good one. This tubular opening is necessary to allow the feed pipe *G*, to project up into the gas-bell. Around the sides of the carbide holder are punched three round holes $\frac{3}{16}$″ diameter; at varying heights from the bottom, the lower one being 1 $\frac{3}{4}$″ from the bottom, the other two each being spaced $\frac{1}{4}$″ higher. As the bell carrying the carbide holder sinks into the water, the water the lowest hole enters, and the generation of acelytene follows. If not enough gas is being made to provide for the demand, the bell continues to sink until the second opening admits water, and a greater quantity of gas made. As soon as the generation of gas is greater than the demand, the bell rises drawing the barbide holder out of the water and generation ceases, the machine being practically self-regulating.

The feed pipe *G*, is a piece of $\frac{1}{8}$″ brass tubing, 17″ long, bent to the shape shown. A hole is punched through the can *A*, near the bottom, the edges of the hole being left with the burr projecting into the can forming a cup to hold the solder and making a stronger joint. The tube is then put in place, the upright part inside the can being placed in the exact centre of the can. The opening where the tube enters the can is then carefully and strongly soldered.

Before soldering however, the outer end of the tube should be threaded to receive an acetylene burner, *H*, which will have to be purchased of some gas fixture dealer. It is also desirable to solder in a brace *L*, made of a strip of tin, $\frac{3}{4}$″ wide, and 6″ long, bent to the shape shown and a hole punched at the apex for the tube.

To avoid flickering, an ordinary lantern may be altered by removing the oil receptable, and attached to the outer end of the feed pipe by soldering on the round, perforated part as shown at *I*. The globe and monitor top can then be attached in the way best adapted to the kind of lantern used, these varying in construction so greatly that no directions are given. This arrangement is used, as the regular out door acetylene globe is very expensive, and this arrangement, while much cheaper, is about as good.

The lamp may be supported on a post in two ways, the one used being by soldering a 2 $\frac{1}{2}$″ round spice box to the bottom, this fitting over the top of a round wooden post. Or a lug can be soldered to the top of the can *A*, and the lamp suspended on a large nail or screw, the head of which is put through a hole in the lug, Either way will answer.



To operate the lamp, fill the carbide holder *C*, *half full* of lump carbide, place inside the bell *B*, put on the cover which is held in place by the spring catches *D*. Place all in the can *A*, which should be half full of water. Gas will soon generate, forcing out the air in the bell and as soon as an odor shows it is coming from the burner it may be lit. Put only enough carbide in the holder to last required time, which can be determined by a few trials. No shut off cock is provided in this lamp, as it is not of a type to use intermittently.

The stock of carbide must be kept in an air tight can to avoid "air slacking", this following continued exposure to the air as with ordinary lime,

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Please mention AMATEUR WORK to your friends.

AMATEUR WORK

63 KILBY ST., BOSTON

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JUNE, 1903.

The receipt of many interesting descriptive articles is acknowledged, with many thanks to those who have responded to the prize offers mentioned in the April issue. These articles are being read, and the prizes will be awarded as soon as possible. A number of the more important ones will be published in the next few issues, and we are sure our readers will read them with interest.

Many readers of this magazine undoubtedly use or know of some useful or interesting novelty, tool or instrument, a knowledge of which would be of value to other readers. That we may obtain information of this kind from readers who are too busy to write out a complete description we make the following offer:

To anyone sending us an acceptable suggestion for the construction and use of any article likely to be of general interest to readers of this magazine, together with rough drawings of same when necessary, we will give any premium mentioned in our premium list as offered for one subscriber, subject to conditions of extra payment, postage, etc.

A little thought, and a few minutes time to write us, may obtain for you a needed tool, or something else in the list you have wanted. Make a trial and send in your suggestions.

The summer months are considered in the publishing business as the dull months. It is our belief that just as much interest in this magazine exists at one season of the year as at another, but to stimulate the activity of readers who are working for subscriptions a special offer, good only until September 1, 1903, is made. Anyone sending in three new subscriptions will be given the premiums usually awarded for four subscriptions, the extra premium being the stimulus to do a little hustling during the period mentioned. Some of our readers are getting quite an equipment of tools in this way and many others could do the same if they make a start.

"In Germany, electricity, among other curious results, has rehabilitated the discarded windmill" says *The Electrical Review*. "At Neresheim a windmill supplies power for thirty-six incandescent lamps that tight a large paint factory. Another in Schleswig-Holstein keeps up a steady current of thirty volts. At Dusseldorf a wind. mill winds up a heavy weight, the descent of which works a powerful dynamo."

A considerable amount of interest has been aroused," says *The Scientific American*, "by the announcement, as the result of a prolonged series of experiments, of a method of so treating timber as to secure even from soft wood a largely increased toughness and hardness. The process is described as one of vulcanizing, comparable in some respects with Bessemer's process of converting iron into steel, and is the invention of Mr. Powell, a Liverpool merchant. The treatment to which the timber is subjected is, roughly speaking, that of saturation at boiling point with a solution of sugar, the water being afterward evaporated at a high temperature. The result is to leave the pores and interstices of the wood filled in with solid matter, and the timber vulcanized, preserved, and seasoned.

ELEMENTARY SHOP PRACTICE.

FREDERICK W. TURNER, Rindge Manual Training School, Cambridge, Mass.

VI. TAPS AND TAPPING.

Most of the screws used in ordinary shop practice have a V thread. The tools for this thread are easier to make, and the thread itself is good enough for all practical purposes. The U. S. standard is used principally on government work and in machines of the better class. The Acme and square threads have their special uses as already outlined, and are never used in ordinary screws such as those in which the amateur is most interested.

FIG. 44. MACHINE SCREW TAP.

Having determined the shape of the thread for our screws, we must have some standard sizes and some gage by which to measure them. As the small screws generally used are called machine

FIG. 45. MACHINE TAP WRENCH.

screws, so the taps for these screws are called machine screw taps. These are made in many different sizes, and pitches, those given in the table being those of common use. The use of a large number of sizes cannot be recommended. It will be noticed that the sizes are from Nos. 2 to 14; these numbers being a purely arbitrary designation, and following no rule. The pitch is made coarser as the size increases; the idea being to keep the strength of the stock left at the root of the thread a little greater than that of the threads themselves.

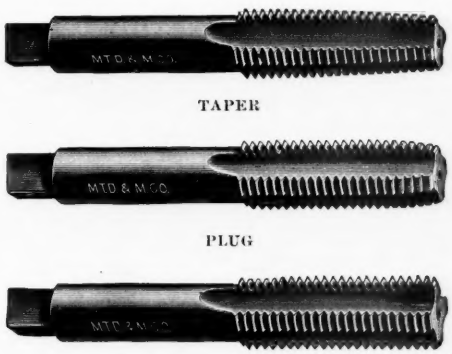


FIG. 46. HAND TAPS.

Having determined the size of the tap to use, it is evident that the hole drilled for tapping must be considerably smaller than the diameter of the tap itself. If a full thread is desired, the diameter of the drill should be the same as the diameter at the root of the thread, or, it should be the tap diameter minus twice the depth of the thread. As the V thread is an equilateral triangle, it is a simple matter to formulate a rule for finding the diameter of any tap drill, a tap drill being understood to mean a drill which will make a hole for a certain sized tap; for example, a 10 x 24 tap drill will drill a hole of the proper size to be tapped with a 10-24 tap. The ratio of the altitude of an equilateral triangle to a side is always .866 to 1; therefore the depth of a thread will be .866 times the pitch. As the amount to be subtracted from the tap diameter is twice this distance, the rule becomes "The tap drill diameter minus 1.732 times the pitch." This, it must be remembered, is correct for a V thread only.

In a similar manner, a rule can be formulated for any shape of thread.

The table shows the size of tap drills for a full thread, and can be used in cast iron. Softer metals, such as wrought iron and brass, tend to squeeze up toward a full thread, even if the tap

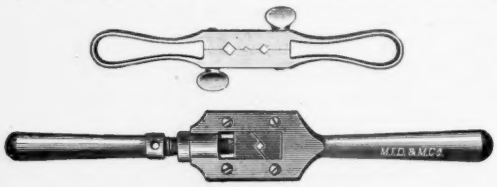


Fig. 47. Small and Large Tap Wrenches.

drill is a little larger than that given in the table, while tool steel is so hard that a tap will not stand the strain of making a full thread without the exercise of extreme care. For these reasons, larger drills are recommended as shown in the table.

Fig. 48. Taper Tap.
Fig. 49. Blacksmiths Taper Tap.
Fig. 50. Adjustable Tap.

For machine screw taps, the T handle or Elterich tap wrench is best adapted, as the tap can be held and turned with one hand. In tapping small work, it is advisable to hold the work in the left hand and turn the tap back and forth, advancing it a little at each turn, with the right hand. The work should be turned from side to side so as to see if the tap is entering the work at the proper angle. More small taps are broken by holding the work in a vise and forcing the taps than from any other cause. With the work held in the hand, any undue strain is quickly noticed. Backing up the tap tends to break up the chips so they can fall out through the flutes

When the size of the tap required is $\frac{1}{4}''$ or over, the machine screw sizes are usually abandoned for the fractional sizes. The standard sizes and pitches from $\frac{1}{4}''$ to $1''$ have been listed, together with the proper tap drills, forming a table which should prove of value. These taps are called "hand" taps, and are usually sold in a set of three, consisting of taper, plug, and bottoming. The machine screw style are all of the plug shape, but, in the larger sizes, it is found that a taper tap starts more easily, while a bottoming tap is necessary to tap to the bottom of a blind hole. The two styles of wrenches shown are used with these taps, and the work is generally held in a vise. To test the accuracy of the starting of the tap, a square may be placed against the shank of the tap at two points 90° apart, if parallel with the axis of the hole in two planes, the tap is started properly. The same precautions regarding backing are necessary in the use of larger taps, but rather to make the work easier than for the safety of the tap.

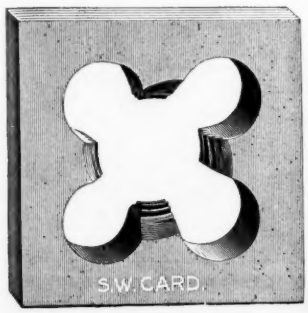
Some form of lubrication is desirable in tapping. Lard oil or a solution of soda and water is used on steel, wrought iron, and brass; cast iron may be tapped dry, but the work done somewhat easier when a small amount of the soda solution is used. For tapping hard rubber, a material much used in electrical instrument work, mutton tallow gives the best results. It may also be used on fibre and other insulating materials.

Adjustable taps are not much used on account of their cost, but they are of great value when it is necessary to tap holes close to size, and also to compensate for the wear of taps which is inevitable and very annoying. One of the simplest forms is shown in the illustration. The blacksmith's taper tap is often a very convenient tool, but its use is not advised where good work is desired, as it is evident that a straight screw cannot

fit properly in a hole which has been taped with a taper tap. The so-called bicycle repair taps are similar to the blacksmith's taper tap, but the amount of taper is less and the threads are usually of finer pitch.

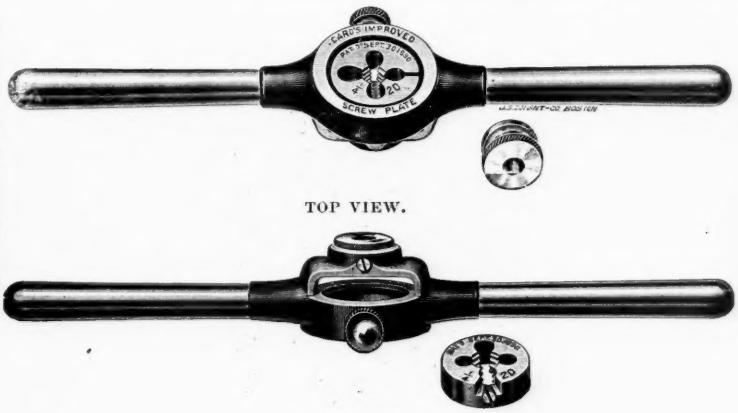
ers for dies above $\frac{1}{4}$" are sometimes provided with adjustable guides to centre the stock.

When the metal is too hard or the thread too coarse to be cut with one passage of the die, as is necessarily the case with the solid die, recourse



SOLID SQUARE DIE.

SOLID ROUND DIE.



TOP VIEW.

BOTTOM VIEW

SCREW PLATE STOCK WITH GUIDE.

JAMB DIES AND STOCK.

FIGS. 51 TO 54. DIES AND DIE STOCKS.

For cutting the external threads to fit these tapped holes, the machinist uses what are known as "dies". In the smallest sizes, several dies may be combined in what is called a die plate. These allow of no adjustment, and wear quite rapidly, but they are cheap and are satisfactory in a great many cases. It is difficult to start them squarely on the work, and they are used more in connection with the lathe than in hand work.

The common form for the machine screw sizes is the solid round die with its holder as shown. Although called a solid die, it is capable of a slight adjustment by means of a screw or pin. The holder prevents the die from opening, and the pin prevents it from closing beyond the point desired; the die, while in operation, being in reality a solid die. Although easier to start square than the die plate, it is not very accurate when used on stock held in the vise. The holding is had to the adjustable dies, called "jam dies". The holder for these dies which is arranged to feed the dies together, is called a screw plate. These dies centre themselves on the stock by be-

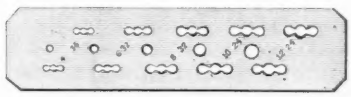


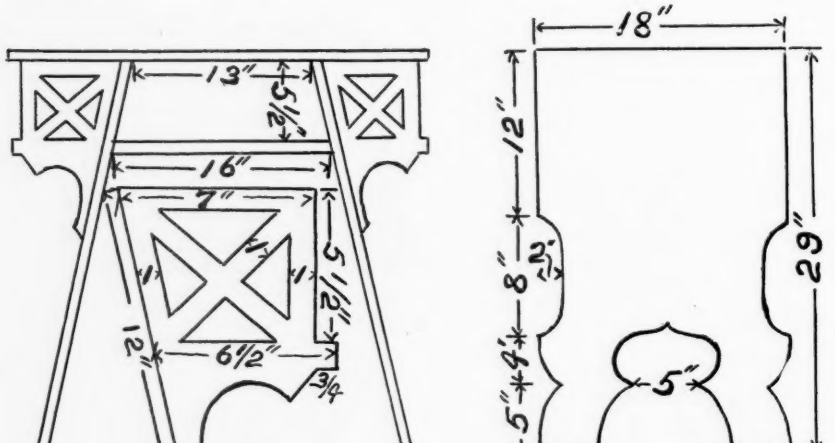
FIG. 55. JEWELLERS PLATE DIE.

ing applied to the outside of it and worked back and forth until a cut which can be easily carried is obtained. The backing up and lubrication spoken of in connection with tapping is necessary in threading with dies of any style.

NOTE; — The tables mentioned in this chapter will be published in the next issue.

A TEA TABLE.

JOHN F. ADAMS.



This table will be found very convenient and servicable, especially if *Madame* makes a practice of serving tea to visitors. The top measures 20"

x 30" and it is 28" high, the stock used being ¾" thick. It may be made of oak and stained or of poplar, gumwood or butternut, and fire etched, this style of table being very effective when so decorated. The top should be of selected stock, carefully glued up so the grain will match correctly.

The shape and dimensions of the two pieces forming the legs are shown in the illustration. These can be sawed out at the mill if a pattern is drawn full size and left with order for the stock. The centre shelf is 17" wide and 16" long, which allows the ends to be bevelled to fit the legs. The edges are cut in 1" deep, and 12" long, with rounded corners.

The shelves at the ends are 15 ½", long, and 5 ½" wide. They are supported by the brackets at the ends, the shape and dimensions of which are shown sufficiently to enable full size patterns to be drawn, so these brackets can be sawed out at the mill or worked out by boring holes and cutting out with compass saw, but this latter way will require considerable filing to make a good looking job.

The table is assembled by first fastening the legs to the centre shelf with screws, the heads

being countersunk. The top is then attached in the same way. The brackets are then attached to the end shelves and then fastened to the legs by screws, put through from the top. Bore holes for all screws. The legs incline at an angle of about 13°, which of course determines the cut on the inner edge of the brackets. Screw holes should be countersunk quite deeply to enable round buttons of wood to be glued over the heads of the screws, concealing their location much better than does putty. The buttons should be glued in.

A 1=4 H. P. HORIZONTAL ENGINE.

B. R. Wicks.

V. FINISHING CROSS-HEAD AND PISTON ROD.

Continuing the work on the cross-head taken up in the last chapter, have at hand a piece of 3-8″ x 5-8″ cold drawn steel for a sizing gage, and mill out the other side of the cored slot so that the gage will push in without any shake. Be careful to feed in the cuts to the same depth, so there will be no burr left, and the same time making a first class job. The mill and arbor can now be removed from between centres, and in place of the usual lathe centre, an end mill about 3-4″ diameter used to mill the two sides.

Set a pair of calipers to slightly over 5-32″ just enough to allow for draw filing and polishing. Starting the mill on the end of the side take two cuts, the last and finishing cut to the size of the calipers, and during this milling operation feed in the mill slowly using lard oil.

To mill the opposite side, the casting will have to be turned over in the tool post and be reset. Take the piece of 3-8″ x 5-8″ steel used for the sizing gage, and place it in the slot. Bring this up until it just touches the face of the mill; run it back and forth until the mill touches all over the gage. This will indicate that the work is square and in line with the milling in the slot and the opposite side.

Start in taking two cuts and the width will be a little over 11-16″ with a 3-8″ slot exactly in the centre and 5-32″ on each side of the 3-8″ slot. This finishes the milling operation on the cross head. The 1-2″ thickness in this case will be filed.

The piston rod can now be finished up to size, but it will have to be recentred. Cut off the end of the rod 4 27-64″ from the centre of the 1-4″ hole for the wrist pin, and rub on a little blue vitrol. Tap into the 3-8″ slot for the connecting rod, a piece of 3-8″ brass in which to make a centre. Drill through the brass with the 15-64″ drill, using the cross head as a gig, and ream out both the cross head and the brass to 1-4″. Have at hand a 1-4″ x 1″ screw and nut, put this screw in the hole, and screw on the nut so that the brass will not move from position. Place the round part of the rod on the V blocks and recentre, taking great pains with it, for this is a very important part of the wotk. Having laid out the centres with particular care, carefully centre with a small centre-drill and counter-sink.

Place the work between centres and turn the piston rod about .002″ larger than the hole in the piston rod gland. In turning up the front face of the cross head, use a small round pointed tool with about a 1-8 radius.

Take all the measurements given on detail drawing No. 384 from the centre of the wrist pin hole. The space of 17-32″ on the end of the rod is for the piston. Turn this about a thousandth larger than the hole in the piston, so that it will tap on by using a small lead or copper hammer. Cut a thread for the piston rod nut 5-16″ long. In cutting this thread, use a 1-4′-20 U. S. S. die and a 9- 32″ guide in the die stock.

Before taking the rod out of the lathe, with a sharp pointed tool, make a light 1-2″ circle on the front face of the cross head to set the surface gage needle to when laying out for the filing on the top and bottom. Make a gauge, the large diameter being 5-8″, and the remainder to fit the hole for the wrist pin. This gage is made to file the round of the cross head to.

Remove from the lathe and rub a little vitrol on the two milled sides of the cross head. Set the piston rod part on V blocks, using a square to square up the side with the top of the surface plate on which the V blocks set. Set the surface block needle to the outer edge of the 1-2″ circle, and make a line on each side without moving it from the position set by the square. Turn the casting over and square it. and make the other two lines, one on each side. This will make the body of the cross head 1-4″ from the centre on each side. Carefully remove the 1-4″ from the hole made for the wrist pin and put in the 1-4″ x 1-8″ gage, and with a sharp scratch, make a line around the outer edge until it reaches the lines made by the surface gage needle. The screw can now be replaced taking care not to move the 3-8 brass plug in doing so.

The casting may now be held in the vise and filed to the outer edge of the lines, using a square and cali-

pers to test the accuracy of the work. After this has been accomplished, replace between centres and file and polish the piston rod, so that the piston rod gland will slide freely without any shake. Highly polish the front end with fine emery cloth and oil. The screw can now be taken out and the brass plug removed, as all the turning is finished on the piston rod. The 1-4″ hole for the cross head shoe stud pin No. 385, the 1-8″ hole for the cross head shoe stud pin, No. 386, and a 3-32″ hole for the key in the wrist pin are now located. These holes are laid out on V block with a surface gage to the figures given on the detail drawings and the greatest care should be taken in getting them exactly central.

HOW TO BUILD AN AUTOMOBILE.

William M. Francis.

IV. ENGINE AND FRAME.

The illustration with the first chapter shows an air cooled, three cylinder motor to be used as a drive for this automobile. As it is a matter of taste or preference as to whether one, two, three or more cylinders are used, and as nearly everyone prefers to have an engine of some standard make which can be bought cheaper and probably give more satisfaction than one an amatcur would be likely to make, it is recommended that either a set of standard castings be bought, with which there are generally furnished a set of blue prints giving all necessarv dimensions, or the eagine be bought complete and ready to run.

In regards to respective merits of water and air cooled motors the chief objection to air cooled motors is, that in climbing a long hill and using the slow speed gear, the engine is running very fast and there is not a sufficient current of air to keep the engine cool. when the engine is cased under the usual hood, without the use of a cooling fan. This objection also holds good if the auto. is standing still with the engine running. The objection to water cooled motors is; that a tank has to be carried to hold the cooling water, and as it is not desirable to carry one large enough to supply water and radiate enough heat to keep the water at a low enough temperature so that the engine can be worked, a radiator has to be added which is generally placed on the front or dash of the auto. The circulation is maintained through it and the engine, either by gravity (difference in the weight of hot and cold water) or a force pump is attached to some part of the mechanism to assist the circulation. Even with this apparatus, it is found that under certain conditions the water will get so hot that the engine cannot be worked and a fan has also to be added. By referring to the plan and elevation shown in the first article, the frame (marked Frame) will be seen. This is preferably of channel iron bent in the shape shown and either welded at the corners, or the ends are mitred and fish-plated together with an angle piece of flat iron bent to the shape and rivetted to the channel iron.

The dimensions are given in the plan to suit standard makes of body which are obtainable of several supply dealers. These dimensions however, may be different for a different style or make of body, and the shape may also be different, so that if it is intended to build the body it will have to suit the frame or vice versa. The front spring is connected to the frame by being bolted to a bearing 3″ wide, 8″ long, and having a 1 1-4″ pin. The pin should be long enough to project through the bearing on one end so as to receive either a nut or a washer and cotter pin. The other end is flat and projects enough from the side of the bearing to be riveted to the under side of the frame. The object of the nut or cotter pin is to keep the springs from spreading, and the pivot connection is to allow a flexible connection so as to make the motion of the front of the carriage independent of the rear. The back springs are connected to the frame by a bar of iron which is shown in the plan with the centre portion broken away. This should be of steel 4″ wide, x 1-2″ thick, and may be reduced in width some in the centre so as to lighten it. It should be offset in the centre as much as the front axle, allowing the same clearance at the part above the differential, as there is between the engine base and front axle, (about 4″). This bar is also riveted to the under part of the frame by 4 3-8″ rivets.

As the position of the cross straps has to be determined by the make and shape of the engine used, and require considerable fitting and bending to get rightly located, they will not be described in this issue, but together with those connected with the gear case, as well as the gear case transmission shafting and steering check will be described in the next number, finishing this series.

The steam yacht Emerald, which recently arrived in New York from Englaud is the first vessel, fitted with a turbine for power, to cross the Atlantic.

A SCREEN DOOR CHECK.

GEORGE H. WILLARD.

A screen door is ordinarily equipped with spring hinges or a spring for keeping the door closed. This causes the door to close with a loud slam unless some means are taken to avoid it. As the door checks sold for this purpose are comparatively expensive, the one here described may interest such readers of this magazine as are troubled with a slamming door.

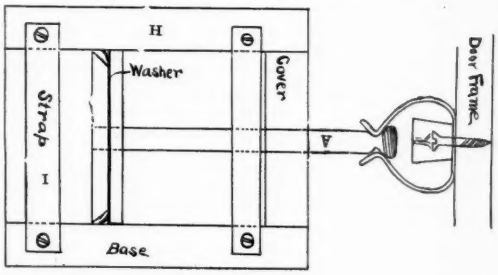
The materials necessary are; a round, tin spice-box, 3 1-2″ x 2″, a piece of round hard wood 4″ long, and 1-4″ diameter; two round pieces of wood closely fitting the inside of the box, and 1-4″ thick; a piece of spring brass, 1 1-2″ long, and 1-2″ wide; a rubber stopper 5-8″ diameter, and some thin, flexible leather for a washer, 2″ diameter.

In the exact centre of the cover of the spice-box, punch a round hole to receive the round rod *A*, with a easy fit, so the rod will slide without binding. Halfway between the centre hole and the edge, punch eight holes 1-8″ in diameter for admitting air. Hammer down all rough edges. Cut out two round pieces of wood *B* and *C*, 1-4″ thick, fitting closely the inside of the spice-box, and bore in the exact centre a 1-4″ hole to receive the rod *A*. Bevel the piece *C*, on the inner edge at an angle of about 45°. Cut the leather washer to a size about 1-8″ larger than the piece *B*; place the washer between the pieces *B* and *C*, and attach permanently to rod *A* with glue. Oil the edges of the washer before gluing to prevent it from taking up the glue and getting hard. Cut in the outer end of the rod *A*, two V shaped slots, one on either side and opposite each other.

Wind several turns of strong wire around the end of the rod, twisting the ends together to hold in place, forming a small knob. This completes the piston, which is now placed inside the spice-box, the edges of the washer being pushed backward in the bevel to get it into the box. The top of the box is then put on, after which the box is then mounted on a small block of wood, *H*, 3 1-2″ x 3″, fastening with two strips *I*, of tin or leather.

To draw the piston out, when the door is opened; a piece of spring brass, *E*, is bent into the shape shown, the outer ends being rounded outwards, so that the knob on the end of rod *A*, will pass by when the door closes. There should be sufficient tension of the arms to pull out the piston when the door is opened, the arms being bent until this is secured. A hole is drilled in the centre for the screw, *G*, the head of the screw being sunk deeply into a small hole cut in the centre of the rubber stopper *F*. This catch is then attached to the door in such a position as to engage with the rod *A*, when the door closes.

In operation when the door is closed the end of rod *A*, rests against the rubber stopper *F*, with the ends of the spring *E*, pressing in the two V shaped slots in



the rod. When the door is opened, the piston is drawn out; the closing of the door being checked by the air back of the piston, the air passing out slowly between the washer and sides of the box. The check is mounted on the casing of the door about two feet from the top, screen-doors being usually of such light construction that they will bend enough so that the bottom of the door would hit the casing, while the top did not, if the check was any higher.

The possible effect of wireless telegraphy sending-stations upon the metal pipes and framework of modern high buildings is discussed by *The Electrical Review*. Says this paper: "We have here vertical conductors of a height approximating those of the usual sending wire, and should the electrical constants of this pipe give it a period of oscillation approximating that impressed upon it from the sending-station, will not this pipe become "charged" and who can tell with what effects? The probable effect of a powerful wireless telegraph sending-station within a large city certainly seems to be a question deserving of the most careful and through consideration."

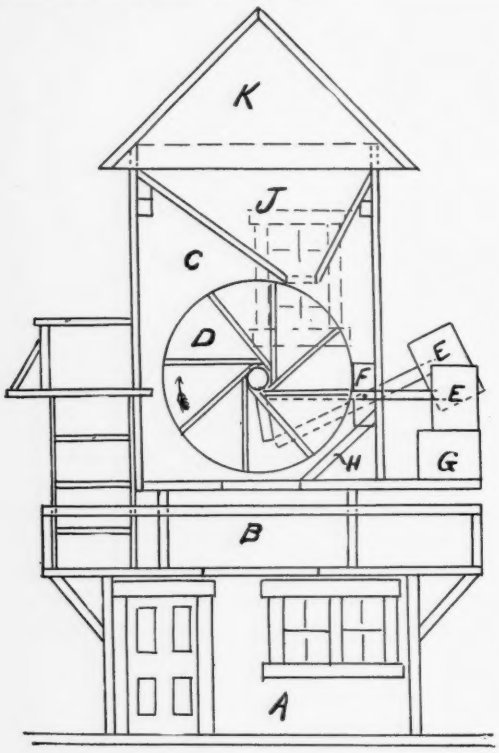
Old tin cans are now converted into window sash and elevator weights, and ballast for boats. The tin covering them is also recovered, to again be used in making various articles.

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

A SAND MILL.

This pleasing toy offers a good opportunity for a boy to show his constructive skill. Although quite easy to make, it yet requires care in shaping and fitting the several parts, so that it will present a good appearance when completed. The wood from cigar boxes will probably be most easily obtained by those desirious of constructing it, and as such wood is well seasoned and of the right thichness, it is nicely adapted to this purpose. A thicker board will be required for the base, which should be about 10″ square.



The lower part *A*, is first made. This is simply a frame 5″ square and 2 1-2″ high. An imitation door is made on one corner and windows on three sides. The fourth side is not fastened to the others, but later is put on with hinges, forming a door through which a tray for holding sand is handled. The top of this part of the mill consists of a board 7″ square, with a hole 2 1-2″ square cut in the centre.

The second story *B* is a box 3″ square, and 1 1-4″ high. When made, it is nailed to the board under it, with nails put through from the under side of this board.

The top story *C*, consists of a box 4″ square and 5 1-2″ high. The board between this and the second story fits into the bottom of this story except on one side where it projects 1 1-2″. Make the size of the board about 3 3-4″ x 5 1-4″, this depending on the thickness of the wood used. One of the sides is made shorter by the thickness of this bottom board to allow for this projection. A hole 1 1-2″ square is cut in this board, the hole being located to come in the centre of the box, as though there was no projection.

The sides of the sand wheel *D*, are round pieces 3″ diameter, with eight buckets made by gluing in eight pieces 1 1-2″ long, and 1″ wide as shown. The inner ends are first nailed to the shaft, which is just long enough to fit across the box without binding, and 3-8″ diameter. The blades are nailed so that one edge will be 1-2″ from one end of the shaft. See that they are nailed on in the way shown so that the wheel will revolve in the direction shown by the arrow. The blades being nailed, the sides of the wheel are put on, 3-8″ holes for the shaft being cut in the centre for same. Bore a 1-8″ hole in the longer end of the shaft 3-8″ from the side of the sand wheel and a second hole at right angles to the first one, 7-8″ from the first hole. Into these holes, fit round pegs 1-8″ diameter and projecting 5-8″. These pegs serve to depress the inn nds of the arms of the stamps. e

In each end of the shaft and in the centre of the front and rear sides of this story, bore small holes to receive round-headed brass screws, forming the bearings for the shaft. This arrangement allows the shaft and wheel to be easily removed, should this be necessary.

The stamps, *E*, are round pieces of wood, 3-4″ diameter, and 1″ long. The arms for same are 1-4″ x 1-8″ and 2 7-8″ long, allowing 3-8″ to insert in holes bored in the stamps, the ends of the arms being rounded to fit the holes and glued in with a drive fit. Drill small holes through these arms, 1″ from the stamps, for wire nail bearings. Cut out four pieces *F*, 1-4″ square and 3-4″ long which are glued to the side of box, after drilling holes in the centre of each for the nail bearings. These holes should be about 1 1-4″ from the bottom board of this story. Holes 3-8″ long and 3-16″ wide are cut in the side for admitting the arms of the stamps, these holes being located directly opposite the pegs in the wheel shaft, and the pieces *F*, being placed on either side of these holes. Small wire nails are put through the holes drilled in the pieces *F*, and the

arms, thus holding the stamps in such a position that, as the wheel shaft revolves, the inner ends of the arms will be depressed until the peg passes off, allowing the stamps to fall with a "click" upon the block *G*.

The block *G*. is 7-8″ x 1″ x 2″ and is glued or nailed to the extension of the floor piece. A piece of wood 3 3-4″ long, and 1 1-4″ wide, the edges being beveled, is glued to the side and bottom of the box to send any sand falling from the buckets, into the hole in the floor. The sand hopper *J*, is made so that the hole in the bottom will be to one side and directly over the buckets on that one side only. The hole through which the sand falls is 1-4″ wide and 3-4″ long. As it is desirable to have the hopper removable, pieces of wood 1-4″ square are fitted around the under edges, the upper sides of these pieces being beveled to fit the hopper. Other pieces 1-4″ square are fastened to the sides, forming ledges upon which the hopper rests.

The roof *K*, is of pyramid shape, the base being 5″ long, and the height at the centre 2 1-2″, the hypothenuse being 3 3-4″. The joints are beveled. care being necessary to get the bevel correct. This is not fastened down, as it is removed whenever it is necessary to fill the hopper with sand.

A small gallery is made on the side opposite the stamps, with railing and a flight of steps connecting it with floor of the second story. This can be constructed with a detailed description. A railing is also put around the floor of the second story; and if the builder cares to take the time, this railing can be made additionally atttactive by using toothpicks for pickets, holes being drilled for same in the floor and hand-rail. This can also be done with the gallery and stairs.

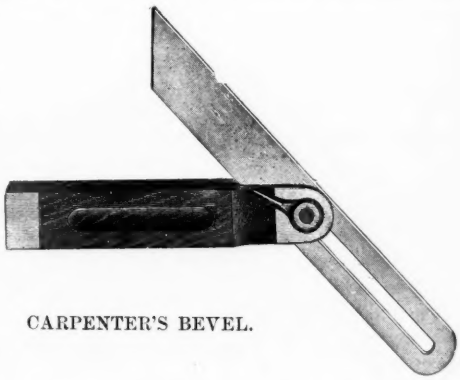
A window can be put through the front side of the third story, through which the sand-wheel can be seen to revolve, and another window at the gallery will show the workings of the cams moving the stamps, A box is made fitting inside the first story to catch the sand falling from the wheel. Thin isinglass used in stove doors can be used to add to the appearance o the windows, sash-bars being lined out with black paint. Hinges can also be painted on the door.

If shingle stain of a gray or green tint is applied to the exterior, the appearance of a weather-beaten old mill may be obtained. The base board should be covered with coarse sandpaper before the mill is finally attached thereto, this being done by putting long, thin screws up through from the under side. A few trees and animlas from a Swiss village will add to the general effect, and complete the making of a very interesting toy and ornament for a boys room.

The readers of this department are requested to suggest topics, which they would like to have presented in these colums. This will enable the publishers to make it as interesting as it is their desire to have it.

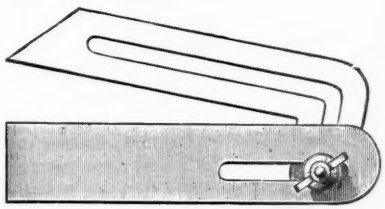
TOOLS AND THEIR USES.

BEVELS. The bevel is used for laying out any desired angles, as well as to ascertain the angles of work already formed. It is similar to a square, with the exception that the blade is not permanently fixed, but may be adjusted to any angle, and temporarily fastened. Its principle use is with angles of other than 45°, these usually being laid out with the *Mitre Square*. If work requires frequent use of the bevel to obtain



CARPENTER'S BEVEL.

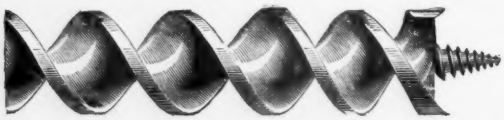
uncommon angles, a *Bevel Protractor* will enable the bevel to be quickly set at any desired angles, but for many angles an ordinary carpenters square can be used as here illustrated. Assume the angle wanted is that of 60° from the horizontal, this being the ratio of 2 to 1 of a right angle. If the bevel be set so that the blade will touch the 3″ mark on one arm, and the 6″ mark on the other arm of the square, this angle will be obtained. Other angles can be set in the same way by calculating the ratio of 90 and then using the same ratio in the square.



MACHINIST'S BEVEL.

The bevel is much used to test work when cutting bevels or clampers. The machinist's bevel is much the same as that used in wood-working but usually much smaller in size. The blade also has a curved extension, giving the tool a little wider range of angles for certain work.

BITS. This familiar tool requires no extended description of its more common forms. The *Auger Bit*, commonly used in a *Bit Brace*, has a screw point, two scoring-spurs and two cutting lips. The screw point draws the tool forward into the wood, being assisted

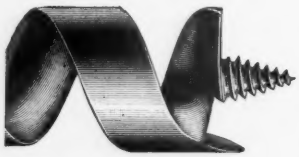


DOUBLE TWIST AUGER BIT.

by pressure applied to the bit-brace. The scoring-spurs cut around the circumference, so that the cutting lips have only a forward cut similar to a plane. The shavings are brought to the surface through the spiral channels. For boring large holes or holes of unusual diameter, the Clark expansive bit with ad-

CLARK'S EXPANSIVE BIT.

justable cutting blades is particularly valuable, as it dispenses with the necessity of an outfit of the large and expensive sizes of auger bits. It is made in two sizes, with two cutting blades for each size; the smaller cutting holes from 1 2″ to 1 1-2″, and the larger from 7-8″ to 3″. As with all good tools, there are inferior imitations of the genuine offered for sale. Those made by R. H. Brown & Co., New Haven, Conn. with this name stamped upon them will be found quite satisfactory, the quality of steel used and the workmanship being the best.



SINGLE TWIST AUGER BIT.

The single twist auger-bit has only one scoring-spur and one cutting-lip, but is much used owing to the rapidity with which it cuts and lifts the shavings; the peculiar formation of the spiral giving greater room for clearance.

A patent bit much used by cabinet makers is the Forstner bit. This bit has no screw point, the scoring edge is quite thin and carried around the circumference further. The cutting lips are identical in action with that of a plane, the result being a hole with very smooth sides and bottom. As it will cut at almost any angle, and leaves no screw hole, it can be used for much work for which the other forms would not be suitable. Model boat makers will find this bit of great value.

FORSTNER BIT.

The German patent gimlet bit is very desirable for boring small holes up to 1-4″ diameter, being obtainable in sizes from 1-32″ to 12-32″ these being well adapted for boring holes for screws, this being the use generally made of them.

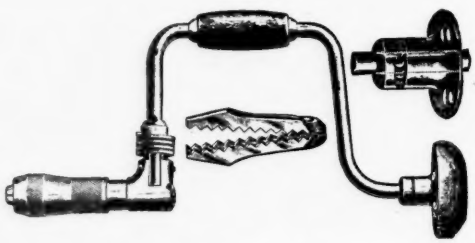
GERMAM PATTERN GIMLET BIT.

The centre bit is used for boring through thin stock, but is not as much used now as formerly.

CENTRE BIT.

The machine bit is useful in boring holes in hard wood, which are particularly desired to be smooth and well formed. As they are obtainable in the small sizes varying by 1-32″ they should be kept in mind by anyone likely to require a size not made in the ordinary forms. The cutting edges are much like the double spur bit.

BIT-BRACE. The bit brace holds the bits, as well as several other useful tools, used in wood working. The prime requisite is that the jaws holding the bits,



RATCHET BIT BRACE.

be so designed and constructed that the bit will be held central, and in line when the brace is being turned. This difficulty will be found in only the most inferior goods, the purchaser being advised to obtain

a fairly good one. The ball bearing head is desirable when much work is being done, the friction being much less with this improvement. The *Ratchet Brace* is very convenient for boring holes in corners where there is not sufficient room for a full turn of the sweep.

EXTENSION BIT HOLDER.

An extension bit holder is used when the work cannot be reached with the ordinary length of bit, but the amateur will have but little use for it. Other tools used with a bit-brace are the screw-driver, countersink, reamers, drills.

BIT DEPTH GUAGE.

BIT GAUGE. A bit gauge is used to regulate the depth of cut. When the bit has reached the required depth, the gauge prevents it going deeper.

CORRESPONDENCE.

OUR readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to editor of AMATEUR WORK, 63 Kilby Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if direct answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

(No. 44.) PROVIDENCE, R, I. May 3, 1903.

I wish to inquire why the term "Arc" light is used? Does the carbon vapor between the points of the carbons assume the forms of an arc, or segment of a circle? If so, how much does the arc deviate from a straight line; and does the frequency make any variation in the form of the arc?

O. L. L.

The carbon vapor passes between the carbon points roughly in the form of an arc but more nearly in elliptical lines. A magnet placed in close proximity to the arc has the effect of distorting the lines, and will even extinguish or break the arc.

(No. 45.) ROCHESTER, N. Y. May 16, 1903.

When and at what price could I obtain a Nernst Lamp, as described in the Jan. 1903, number of AMATEUR WORK, suitable for a direct current of 110 volts? When an alternating current of high voltage is sent through the primary coil of a transformer, such as we see on lighting circuits outside of buildings, is the secondary or induced current, which is sent through the incandescent lamps in the buildings, also an alternating current, or is it a continuous or direct current?

F. A. H.

Nernst Lamps are now on sale by the leading electrical supply dealers of all the large cities. A letter to the Manhattan Electric Supply Co., Cortlandt St., New York, will obtain a descriptive circular and prices or the Nernst Electric Co., Pittsburg, Pa.

The secondary current from a transformer would be the same as the primary; in this case an alternating current. About all incandescent lighting circuits are alternating, the alternations being so rapid as not to be visible to the eye, without the aid of instruments constructed for this particular purpose.

(No. 46.) SAN FRANCISCO, CAL. May 15, 1903.

I have, for a long time, been trying to find some means to burn crude oil in a common gas engine, but with little success. I wish to build a small power plant, and as crude oil is very cheap here I desire to use it. If I were to use anything but crude oil the expense would be so great as not to make the installation pay. If you know how I can make a carburetor using crude oil, or where I can get the information, or even where I can buy one complete, kindly let me know and I will be much obliged to you. I am a very interested reader of AMATEUR WORK, and am always waiting for my next copy to arrive.

Anything you can do for me in the way of carburetors, will be fully appreciated,

E. A. B.

The use of crude oil as fuel for power purposes has not been successfully developed to our knowledge, except in connection with steam plants, steam being required to break up the consistency of the oil, and aid in spraying it into the furnace. If the plant you desire is of a size to warrant the use of steam, you can undoubtedly find places in your city where oil is being used in this way, and from an inspection of which you can determine whether it can be adapted to your use or not. If only a small power is wanted at irregular intervals, a water motor might serve the purpose, if the pressure is adequate.

(No. 47.) WASHINGTON, D. C. May 16, 1903.

Can you send me the name of a firm selling castings for a water-motor 1-8 H. P. or higher?

C. E. S.

Chandler & Farquhar, Federal St., Boston, can probably supply you with castings for a water motor of the size you mention. The Frase Co., Cortland St. New York. have one of a larger size, and might be able to supply you with the castings.

(No. 48.) PERTH AMBOY, N. J. May 26, 1903.

Where are some of the best trades schools located in the Middle or New England States?

S. B. G.

You do not state the particular trade you are interested in. The New York trade school is one of the leading schools for carpentry, plumbing, electric house and line work, iron work, plastering, printing, decorating, etc.. A letter to them will secure catalog. There are no distinctly trade schools in New England, other than the textile schools.

(No. 49.) RENWICK, IOWA. May 28, 1903.

Will the current from a one-half or one inch induction coil instantly kill a mouse or rat? Is double cotton covered magnet wire, No. 36, any better for winding a one inch induction coil than single cotton covered?

R. C. F.

The current from coils the sizes mentioned or even much larger would not kill small animals. While the voltage is high, the quantity of current or amperage is so very small as to have no injurious effect.

The single covered wire would be best, if the insulation between layers is well done.

(No. 50.) MONTREAL, P. Q. June 1, 1903.

I am preparing plans for a fore and aft compound surface condensing marine engine for a launch, with cylinders as follows:

Diameter of H. P. cylinder	4 1-2″
,, ,, L. P. ,,	9 1-2″
Stroke of both ,,	9″
Boiler pressure	200 lbs.
Revolutions per minute	450 lbs.
Crank angles	90

Will you please tell me at what part of the stroke, steam should be cut off at in cylinders? The engine will be built on steel columns, and all pumps and connections will be gun metal. Pipes will be copper. Condenser will be a D shaped copper placed outside the boat.

T. R.

With the high steam pressure mentioned, the cut off should be at about quarter stroke. With a link motion, it can be linked up to cut off earlier. With a common slide valve, it will be found difficult to arrange the lap and travel of the valve, without choking the exhaust so much that the exhaust port will have to be clipped to such an extent as to get what is known as a "minus lap", *i, e,* the exhaust will shut off earlier than is desirable, and the exhaust edge of the valve have been cut away so much that at mid-position, both steam ports will be open. The Myers riding cut-off is a desirable type to use in a compound engine at the pressure given. Cutting off at the above mentioned point. without using the Myers cut-off, it will be found that at certain positions of the stroke, the engine cannot be started with the high pressure, without pulling around by hand. If the condenser is placed outside the boat, it is termed a "keel condenser."

BOOKS RECEIVED.

PHOTOGRAPHIC LENSES. CONRAD BEEK, AND HERBERT ANDREWS, 288 pp. 75 cents. TENNANT AND WARD, NEW YORK CITY.

The amateur photographer, as well as the professional, will find the information contained in this book of much practical value. Without being too scientific, the subject of photographic optics is treated with sufficient attention to detail, to be a practical working guide, which no one, who aims to pass beyond the "press the button" stage can well do without. A careful perusal of the contents, will convey to the reader a pretty complete knowledge of the design and rightful use of a large variety of lenses.

As the authors have had an extended experience in the manufacture and use of lenses, the book carries an authority not always to be found on such works.

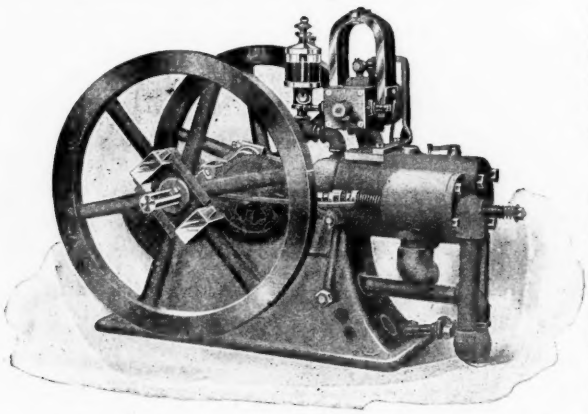
If the present rate of consumption of timber continues, at it probably will unless reduced by a greatly increasing cost, the available supply in the United States will be exhaused in about thirty years. Extensive measures must be generally taken in the way of timber culture, if this is to be avoided.

It is becoming a generally accepted theory that flies are a very active medium for the transmission of disease producing bacteria. This being the case, the precaution for excluding them from dwellings, and the killing of those that enter, should receive careful attention from housekeepers.

A new form of arc-lamp carbons, in which the salts of barium and lime are combined with the carbon, give a greatly increased light over the ordinary form. The conductivity is also higher, so that a much larger arc can be used.

TRADE NOTES

We illustrate on this page a 1-2 H. P. gas or gasoline engins which is being put on the market by the Carlisle & Finch Co. This engine is made for either gasoline or gas and is furnished complete with magneto, spark coil, battery, gasoline tank and water tank, ready to start as soon as placed on its foundation. This engine is constructed in the best possible manner and operates on the four cycle principle. The crank shaft is of steel with babbitted bearings. The connecting rod is of a channel cross section and is so arranged that the cylinder lubricator not only lubricates the cylinder, but the surplus oil drops into the top of the connecting rod and flows to each end, thus lubricating both crank pin and the pin in the piston.



The cylinder dimensions are 3″ bore and 4″ stroke, while the complete weight is 175 pounds. It will be noticed that an extra large fly wheel is furnished so that the engine runs quite steadily and may be used in operating small electric light plants. A shaft governor is provided which operates on the hit and miss principle holding open the exhaust valve when the engine runs too fast.

The magneto is driven by a friction wheel from the fly wheel. No batteries are necessary in starting. One or two turns of the shaft by means of the starting crank which is furnished is sufficient to set the engine in motion and it will take care of itself as long as gas or gasoline is supplied. The cylinder is thoroughly water-jacketed as well as the cylinder head. Thy valves are large and there is no wire drawing on the inlet or exhaust passages.

In order to deaden the noise of the mixing valve, the air for same is taken through the base of the engine. The igniter has hard Platinum-Iridium sparking points which are practically indestructible. One cylinder lubricator is sufficient to lubricate the entire engine with the exception of the bearings, provision for oiling which is made in the tops of the bearing caps themselves.

The engine is a beautiful piece of work, well balanced, quiet running and should be a great favorite with the readers of this magazine. The Carlisle & Finch Co. will be very glad to send full particulars, and can furnish either the complete machine or set of castings with working drawings.

F. L. Goldsmith, the lumber dealer, at 19 Chardon St., Boston, makes a specialty of picking up extra finely marked lumber, which those interested in cabinet or furniture making should bear in mind. He recently secured a fine piece of olive, which some fortunate reader of this magazine can secure by an early application for same.

One great difficulty met by the amateur wood worker is that of keeping his saws in good condition. This necessitates a saw set, of which there is none better than those made by Chas. Morril, 277 Broadway, New York. The bench stop made by the same firm is also a desirable tool.

The Bernard Steel Plyers, nippers, punches, etc., are well liked by those whohave used them. Light and yet very strong, they are especially adapted for the use of electrical workers.

Any amateur who has no suitable work bench and wants one well designed and made, should send for the catalog of A. L, Bemis, 5 Cypress St. Worcester, Mass. He makes several styles of benches well adapted for amateurs as well as a fine line for manual training schools.

Readers of this magazine who are interested in water motors should write The Frase Co., 38 Cortland St. New York. This company having on hand a few of about 1-8 and 1-4 H. P. which they offer at a very reasonable prices. Write at once if you want one.

The Pullen cell manufactured by Leon W. Pullen Electric Co., Philadelphia Pa. in a new applicant for patronage, which it is rapidly securing as its merits become known. Not only is it a galvanic battery, but may also be used as an accumulator, and charged in the usual way. Amateur electricians should give this an early investigation by a trial order.

Clark & Smith, 231 Medford St., Charlestown, Mass. are particularly well stocked to supply the needs of cabinet and furniture makers, as they handle a wide variety of well seasoned lumber. Bunker Hill cars pass the door, mail orders will receive their prompt attention.

The Handy Drawing outfit made by J. & G. Rich, 120 N. 6th. St. Philadelphia, is something every draftsman should investigate. It is a great labor saver.

PREMIUM No. 105.

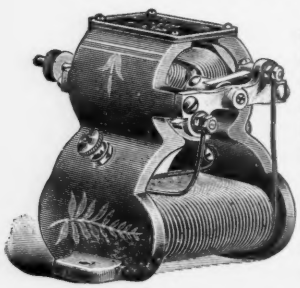
Two Battery Telephones

These telephones are well made, durable and will give good service up to 500 yards between stations. Just the thing to connect house and stable or factory, or the homes of two boys. Directions for wiring are included with each instrument. Two dry cells at each instrument will supply ample current.

Given For Ten New Subscribers. Sent by express, charges paid by receiver.

PREMIUM No. 106

Electric Motor, No. 1

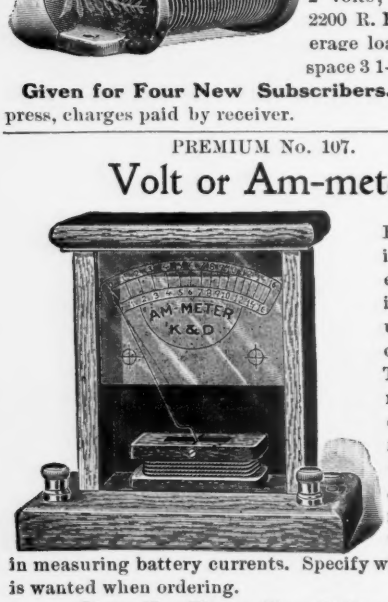


A toy motor larger and more powerful than the one offered as premium No. 102. Especially adapted for propelling mechanical toys. Finished in black enamel with nickel trimmings. Will run from one cell; 2 volts; 1 1-5 amperes. 2200 R. P. M., with average load. Occupies a space 3 1-2 inches square

Given for Four New Subscribers. Sent by express, charges paid by receiver.

PREMIUM No. 107.

Volt or Am-meter



Each instrument is hand calibrated, and will register accurately up to 15 Volts or Amperes. They are made of nicely polished cherry with nickel-plated binding posts Just the thing for use of amateur electricians in measuring battery currents. Specify which instrument is wanted when ordering.

Given For Three New Subscribers.
Postage 22 Cents.

PREMIUM No. 108.

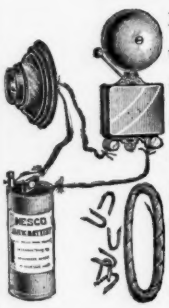
Battery Rheostat

For regulating currents to miniature battery lamps, small motors, etc., this rheostat is just what is wanted. It is well made, and nicely finished with nickel plated trimmings and rubber handle. Resistance 5 Oh.

Given For One New Subscriber and 10 cents extra.
Postage 10 Cents

PREMIUM No. 109

Electric Bell Outfit



Including 1 Iron Box Bell, Push Button, Battery, 75 Feet Insulated Wire, tacks, etc., making a complete outfit for call-bell to boy's room or elsewhere, An excellent thing with which to begin electrical work. With two of these sets, a very complete call-bell service for two entrances to a house can be installed.

Given For One New Subscriber and 20 cents extra.
Two Sets Given For Three New Subscribers.
Sent only by express; charges paid by receiver.

PREMIUM No. 110

Hand Search Light

Complete with battery ready to use. Well made and very useful for illuminating dark places where an open flame would be dangerous. Handy to carry on dark nights or as an emergency light about the house.

Given For Two New Subscribers and 25 cents extra.
Postage 25 Cents.